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IMago**IN THE UNITED STATES PATENT AND TRADEMARK OFFICE**

Appln No.: 10/044,777 )

Filed: January 11, 2002 )

Applicant(s): Marc Chason et al. )

Title: SEMICONDUCTOR PACKAGE  
DEVICE AND METHOD )

Art Unit: 2813 )

Examiner: Jennifer M. Dolan )

Attorney Docket No.: CM01533I (72804) )

Customer No.: 22242 )

Confirmation No. 8364

**CERTIFICATE OF MAILING**

I hereby certify that this paper is being deposited with the United States Postal Service with sufficient postage as first class mail in an envelope addressed to the Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450, on this date.

04/01/2004

Date

Steven G. Parmelee  
Registration No. 28,790  
Attorney for Applicant(s)

**TRANSMITTAL OF APPEAL BRIEF**

Commissioner for Patents  
P.O. Box 1450  
Alexandria, VA 22313-1450

Sir:

Applicant(s) hereby appeal(s) to the Board of Patent Appeals and Interferences from the decision of the Primary Examiner dated October 31, 2003 finally rejecting claims 1-28.

The item(s) checked below are appropriate:

- ☒ Appeal Brief Fee, other than a small entity ..... \$330.00
- ☒ Enclosed is Applicant's Appeal Brief (in triplicate).
- ☐ Enclosed is Petition for Extension of Time (in triplicate).
- ☐ Not required (fee paid in prior appeal in this application).
- ☒ The Commissioner is hereby authorized to charge any additional fees which may be required in connection with this appeal (specifically including the fee for filing a brief in support of this appeal if such brief is filed unaccompanied by full


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payment therefor, and the fee for filing a request for an oral hearing if such request is made unaccompanied by full payment therefor), or credit any overpayment to Deposit Account No. 06-1135. Should no proper payment be enclosed herewith, the Commissioner is authorized to charge the unpaid amount to Deposit Account No. 06-1135. This Notice is filed in duplicate.

Respectfully submitted,

April 1, 2004

Date

  
Steven G. Parmelee  
Registration No. 28,790

FITCH, EVEN, TABIN & FLANNERY  
Suite 1600  
120 South LaSalle Street  
Chicago, Illinois 60603-3406  
Telephone: (312) 577-7000  
Facsimile: (312) 577-7007



**(3) Status of Claims**

Claims 1-28 stand twice rejected and are presently under final rejection. This appeal is from the rejection of claims 1-28.

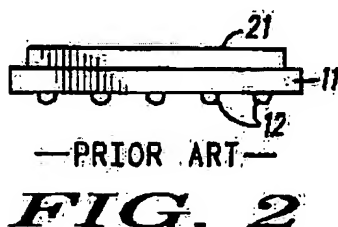
**(4) Status of Amendments**

No amendments have been filed subsequent to the final rejection.

**(5) Summary of Invention**

An interposer having at least one semiconductor die attached to a first side thereof also has, prior to placement on a printed wiring board, an underfill material disposed at least partially thereon.

In general accord with prior art practice, an interposer package can comprise an interposer (11) having at least one semiconductor die (21) disposed on one surface thereof and one or more interface electrodes (12) disposed on an opposing surface. [Page 4, Lines 6-9.] Fig. 2 (as reproduced below for the convenience of the reader) illustrates these features.



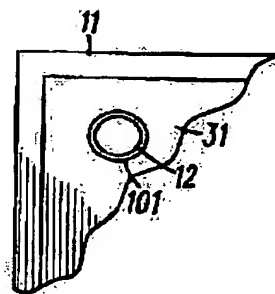
A layer of underfill material (31) covers the interface electrode side of the interposer (11) as illustrated in Fig. 3 (reproduced below for the convenience of the reader).



In one embodiment, the underfill material (31) is disposed over the already placed interface electrodes (12). In such an embodiment, the underfill material (31) is then selectively removed to partially expose the interface electrodes (12) (see Fig. 4 as reproduced below for the convenience of the reader) [Page 4, Line 20 - Page 5, Line 18.].

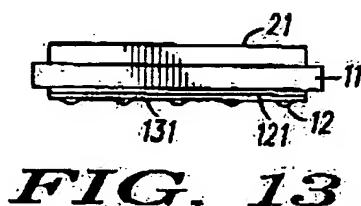


Pursuant to another embodiment, the underfill material is placed on the interposer prior to placement of the interface electrodes. In one embodiment of this approach, apertures (101) are formed as the underfill material is being deposited. (See Fig. 11 as reproduced below for the convenience of the reader).



In another embodiment for this approach, the apertures are formed subsequent to deposition of the underfill material. In either case, the interface electrodes are then formed within the apertures. [Page 7, Lines 1-15.]

Pursuant to one embodiment, the underfill material is formed through a series of deposited layers as shown in Fig. 13 (reproduced below for the convenience of the reader).



This specification also teaches that the plurality of such packages can be simultaneously processed and then singulated as desired. The specification also teaches that such singulated packages can be disposed within corresponding pick-and-place carriers such as a tape and reel carrier.

**(6) The Issues**

Claims 1 and 4-13 are rejected under 35 USC 103(a) given Capote, et al. (U.S. Patent No. 6,335,571) ("Capote") in view of Lin (U.S. Patent No. 5,258,648) ("Lin"). Claims 1-3 and 21-28 are rejected under 35 USC 103(a) given Lin in view of Capote. Claims 14-18 are rejected under 35 USC 103(a) given Lin in view of Capote and further in view of Grube, et al. (European Patent Publication No. 0 475 022) ("Grube"). Claims 19 and 20 are rejected under 35 USC 103(a) given Lin in view of Capote and further in view of Grube and further in view of Spigarelli, et al. (U.S. Patent No. 5,251,266) ("Spigarelli").

**(7) Grouping of the Claims**

Group 1: Claims 1 and 14-20.

Group 2: Claims 2-4 and 21-28.

Group 3: Claims 5-8.

Group 4: Claims 9-11.

Group 5: Claims 12 and 13.

**(8) Arguments**

**Group 1**

Rejection under 35 USC 103

Claim 1 has been rejected under 35 USC 103(a) given Capote in view of Lin and also given Lin in view of Capote.

Capote teaches the use of two underfill materials to bridge a gap between a die and a substrate. Capote particularly suggests that a first underfill material be applied to the die and a second, different underfill material be applied to the substrate prior to combining the two pieces into a common assembly. Consequently, Capote does not teach providing a complete “underfilling” on either the die or the substrate alone. Rather, it is the final combination that provides sufficient material to actually “fill” the available space. To put it another way, Capote teaches disposing an underfill material on a die, and to then place that underfill material on another layer of underfill material as versus directly on a substrate.

Capote also does not teach the use of an interposer. The examiner suggests that using an interposer (for example, by borrowing the concept from Lin) can be introduced into Capote from another reference. Making such a combination, however, requires the person of average skill in the art to ignore the teachings of the Capote reference itself. In particular, Capote makes the following statement in his description:

In the past, the problem of solder joint fatigue life in flip-chip/substrate interconnects is addressed by several methods. A typical approach, which is described in U.S. Patent No. 5,801,449, involves positioning an interposer made of flexible circuitry between the chip and the solder joints. The flex circuit undergoes expansion and contraction without distorting the solder joints despite the presence of the air gap around the solder joints.

Capote then notes the prior practice of using an underfill material between a die and a substrate, and distinguishes the latter from the former as follows:

Unlike the previous interposer methods, there cannot be an air gap or separation between the underfill (104) and the tip (100) or the substrate (101).

Capote, then, is clearly shown to both note the use of interposers and to teach the reader that such interposers are to be used *without* an underfill material. Furthermore, while Capote offers numerous criticisms of the prior art underfill processes, he suggests no issues whatsoever with interposers. Instead, interposers are set forth in Capote as being a satisfactory stand-alone solution. In short, Capote teaches that interposers and underfill materials are different, alternative approaches to reliably securing a die to a substrate, and his teachings regarding the use of a two layer underfill material are solely directed to the latter and not to the former.

Consequently, the applicant respectfully submits that one skilled in the art, upon reviewing Capote as a whole, would not be led to move in a fashion contrary to the explicit teachings of Capote and nevertheless utilize an interposer when also using Capote's two layer underfill process.

Lin is cited for its disclosure of an interposer/die combination that is disposed on a substrate and wherein an underfill material is added after mounting the interposer on the substrate. Lin makes no suggestion that the underfill material could or should be added to the interposer prior to disposing the interposer on the substrate.

Furthermore, a combination of Lin and Capote, regardless of which reference is viewed as a starting point, fails to achieve the claimed invention. In particular, Lin teaches that an underfill material can be added between an interposer and a substrate *following* a combination of the two. Capote teaches that an underfill material can be used to mount a die to other underfill material that has been disposed on a surface to which the die is being coupled. A forced combination of Capote and Lin is therefore likely to yield a structure wherein the die couples to the interposer with two underfill materials disposed therebetween and wherein another underfill material is added between the interposer and the substrate once those two structures have been joined. Such a structure does not meet the recitations of these claims. For example, Claim 1 requires that a non-conductive underfill material be disposed on a side of the interposer prior to placing the interposer on a printed wiring board. Neither



Capote nor Lin makes such a suggestion, nor will a combination of the two yield such a structure.

Claims 14-20 are ultimately dependent upon Claim 1, which Claim has been shown allowable above. In addition, these Claims provide additional limitations regarding the use of a plurality of interposers, singulation of interposers, and various relationships of the underfill material with respect to such interposers.

## **Group 2**

### **Rejections under 35 USC 103**

Claim 2 is dependent upon Claim 1, which Claim has been allowable above. In addition, Claim 2 further specifies that the interposer have at least one interface electrode disposed on the side that also bears the non-conductive underfill material. Claim 2 was rejected under 35 USC 103(a) given Lin in view of Capote.

Lin does disclose an interposer having interface electrodes disposed between itself and the substrate to which it is attached and which electrodes are on the same side of the interposer as the side where the underfill material is added. Lin only teaches, however, that such underfill material should be added after mounting the interposer on a substrate. Neither Lin nor Capote makes any teaching that an underfill material can be placed on an interposer in a way that accommodates such interface electrodes. In particular, the applicant presents teachings wherein such electrodes are later disposed within apertures provided for this purpose or are revealed through a material removal process when the underfill material is added subsequent to placement of the interface electrodes but prior to placement of the interposer on a substrate. Such actions are helpful in order to facilitate the provision of such interface electrodes on the side of an interposer that includes a pre-placed underfill material. Neither Capote nor Lin makes any suggestion, however, as to how such a structural result might be provided. The Claims of Group 2 include this specific limitation and the applicant therefore respectfully submits that these Claims are allowable over the Capote/Lin combination for the reasons stated.

**Group 3**

Rejections under 35 USC 103

These claims provide specific details regarding the addition of an interface electrode to the underfill material bearing side of the interposer after the underfill material has been disposed on the interposer. Claim 5 specifically requires subsequent placement of the interface electrodes. Claim 6 specifies subsequent placement of such electrodes in an aperture that is formed simultaneously with placement of the underfill material. Claim 7 specifies placement of the electrode in such an aperture. Claim 8 specifies formation of at least one aperture in the non-conductive underfill material and further specifies adding the at least one interface electrode in the at least one aperture.

Neither Capote nor Lin, alone or in any reasonable combination, teach, suggest, or result in such configurations. The applicant therefore asserts that claims 5 through 8 each presents supplemental and incremental independent grounds of patentability.

**Group 4**

Rejections under 35 U.S.C. 103

These claims provide specific details regarding formation of the underfill material/layer. Claim 9 specifically requires disposing the underfill material as a plurality of layers prior to placement of the interposer on a board (as distinct from the prior art description of only a single layer being disposed on the interposer prior to placement on a board). Claim 10 specifically requires low-temperature processing of at least one layer of the multi-layer underfill material. Claim 11 specifically requires that the low-temperature processing include low-temperature drying.

Neither Capote nor Lin, alone or in any reasonable combination, teach, suggest, or result in such configurations. The applicant therefore asserts that claims 9 through 11 each presents supplemental and incremental independent grounds of patentability.

**Group 5**

Rejections under 35 U.S.C. 103

These claims provide specific details regarding selective removal of underfill material. Claim 12 specifically requires removing a portion of the underfill material to expose at least a

portion of at least one interface electrode. Claim 13 specifically requires effecting such removal using at least one of chemical polishing, abrading, grinding, mechanical polishing, and laser ablation.

Neither Capote nor Lin, alone or in any reasonable combination, teach, suggest, or result in such configurations. The applicant therefore asserts that claims 12 and 13 each presents supplemental and incremental independent grounds of patentability.

#### **(9) The Claims**

1. (Currently amended) A method comprising:
  - providing an interposer having at least one semiconductor die attached to a first side thereof;
  - prior to placing the interposer on a printed wiring board, disposing ~~an~~ a non-conductive underfill material on at least a portion of a second side thereof.
2. (Original) The method of claim 1 wherein providing an interposer includes providing an interposer having at least one interface electrode disposed on the second side thereof.
3. (Original) The method of claim 2 wherein providing an interposer having at least one interface electrode disposed on the second side thereof includes providing an interposer having at least one interface electrode comprising one of a solder bump and a solder ball disposed on the second side thereof.
4. (Original) The method of claim 1 and further comprising adding at least one interface electrode to the second side of the interposer.
5. (Currently amended) The method of claim 4 wherein adding at least one interface electrode to the second side of the interposer includes adding at least one interface electrode to the second side of the interposer after disposing the non-conductive underfill material.

6. (Currently amended) The method of claim 5 wherein disposing ~~an~~ a non-conductive underfill material includes disposing ~~an~~ a non-conductive underfill material on at least a portion of the second side thereof while simultaneously providing at least one aperture in the non-conductive underfill material.
7. (Currently amended) The method of claim 6 wherein adding at least one interface electrode to the second side of the interposer after disposing the non-conductive underfill material includes adding at least one interface electrode in the at least one aperture.
8. (Currently amended) The method of claim 5 and further comprising forming at least one aperture in the non-conductive underfill material and wherein adding at least one interface electrode includes adding at least one interface electrode in the at least one aperture.
9. (Currently amended) The method of claim 1 wherein disposing ~~an~~ a non-conductive underfill material includes disposing a plurality of material layers.
10. (Original) The method of claim 9 wherein disposing a plurality of material layers includes exposing at least one of the material layers to low-temperature processing.
11. (Currently amended) The method of claim 10 wherein exposing at least one of the material layers to low-temperature ~~drying~~ processing includes exposing each of the material layers to low-temperature drying.
12. (Currently amended) The method of claim 1 and further comprising removing at least a portion of the non-conductive underfill material to expose at least a portion of at least one interface electrode.

13. (Currently amended) The method of claim 12 wherein removing at least a portion of the non-conductive underfill material includes using at least one of chemical mechanical polishing, abrading, grinding, mechanical polishing, and laser ablation to expose at least a portion of at least one interface electrode.

14. (Original) The method of claim 1 wherein providing an interposer having at least one semiconductor die attached to one side thereof includes providing a plurality of interposers disposed substantially co-planar to one another, wherein at least some of the interposers each have at least one semiconductor die attached to one side thereof.

15. (Original) The method of claim 14 wherein providing a plurality of interposers includes providing a plurality of singulated interposers.

16. (Original) The method of claim 14 wherein providing a plurality of interposers includes providing a panel comprised of a plurality of interposers.

17. (Currently amended) The method of claim 14 wherein disposing ~~an~~ a non-conductive underfill material on at least a portion of the second side of the interposer includes disposing ~~an~~ a non-conductive underfill material on at least a portion of the second side of at least some of the plurality of interposers.

18. (Currently amended) The method of claim 17 and further comprising, after disposing the non-conductive underfill material, singulating the interposers to provide singulated interposers.

19. (Original) The method of claim 18 and further comprising placing at least some of the singulated interposers into a carrier to facilitate subsequent placement of the singulated interposers on a printed wiring board.

20. (Original) The method of claim 19 wherein placing at least some of the singulated interposers into a carrier includes placing at least some of the singulated interposers into at least one of a tape and reel carrier, a waffle pack, and a matrix tray.

21. (Currently amended) A method comprising:

- providing a printed wiring board;
- providing at least one interposer having:
  - a first side having at least one semiconductor die affixed thereto;
  - a second side having:
    - ~~an~~ a non-conductive underfilling material disposed thereon; and
    - at least one interface electrode at least partially exposed through the non-conductive underfilling material; and
- disposing the at least one interposer on the printed wiring board.

22. (Original) The method of claim 21 wherein the at least one interface electrode comprises one of a solder ball and a solder bump.

23. (Currently amended) The method of claim 21 and further comprising further processing the at least one interposer on the printed wiring board to at least partially harden the non-conductive underfilling material.

24. (Currently amended) The method of claim 23 wherein further processing includes heating the non-conductive underfilling material.

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25. (Currently amended) A device comprising:

a pre-placement interposer having:

- a first side having at least one semiconductor die affixed thereto; and
- a second side having:
  - ~~an~~ a non-conductive underfilling material disposed thereon; and
  - at least one interface electrode at least partially exposed through the non-conductive underfilling material.

26. (Original) The device of claim 25 wherein the interposer comprises means for physically and electrically coupling a semiconductor die to a printed wiring board.

27. (Currently amended) The device of claim 25 wherein the non-conductive underfilling material comprises adherence means for physically coupling the interposer to a printed wiring board.


28. (Currently amended) The device of claim 25 wherein the second side has a plurality of interface electrodes at least partially exposed through the non-conductive underfilling material.

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**Conclusion**

The applicant respectfully submits that claims 1 through 28 are allowable over the art of record.

Respectfully submitted,

By:   
Steven G. Parmelee  
Registration No. 28,790

Date: April 1, 2004

FITCH, EVEN, TABIN & FLANNERY  
Suite 1600  
120 South LaSalle  
Chicago, Illinois 60603-3406  
Telephone: (312) 577-7000  
Facsimile: (312) 577-7007